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Treatment results of blunt suprahepatic vena cava injuries at a single trauma center, Korea: a case series

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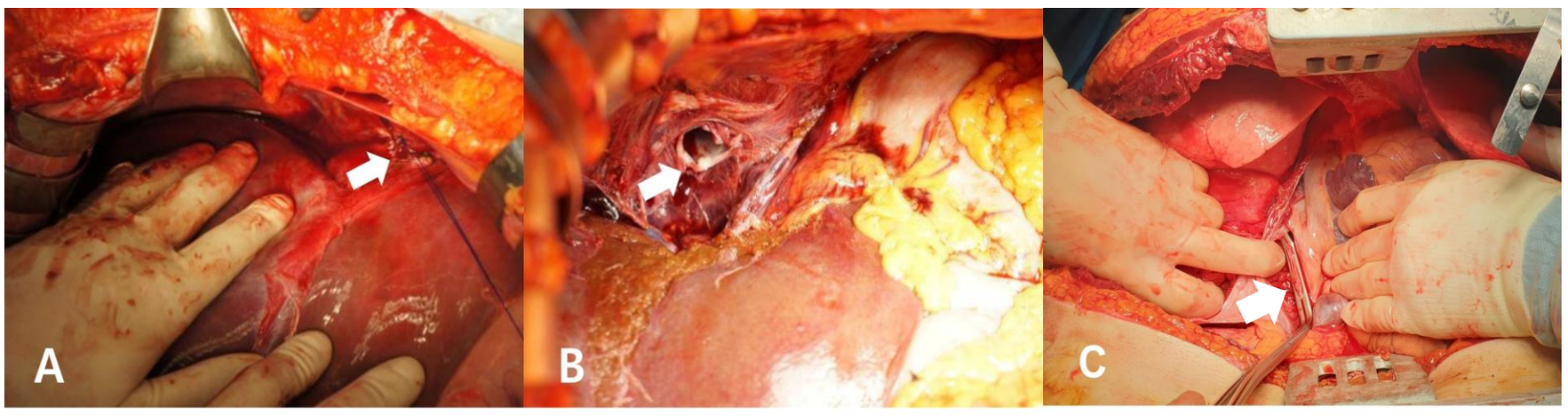


Fig 1. Surgical findings of SHIVC injuries,
A. SHIVC injury after primary repair, patient No. 1,
B. Transected suprahepatic IVC, patient No. 7,
C. Longitudinal tearing of intrapericardial segment of suprahepatic IVC with satinsky clamp, patient No. 10

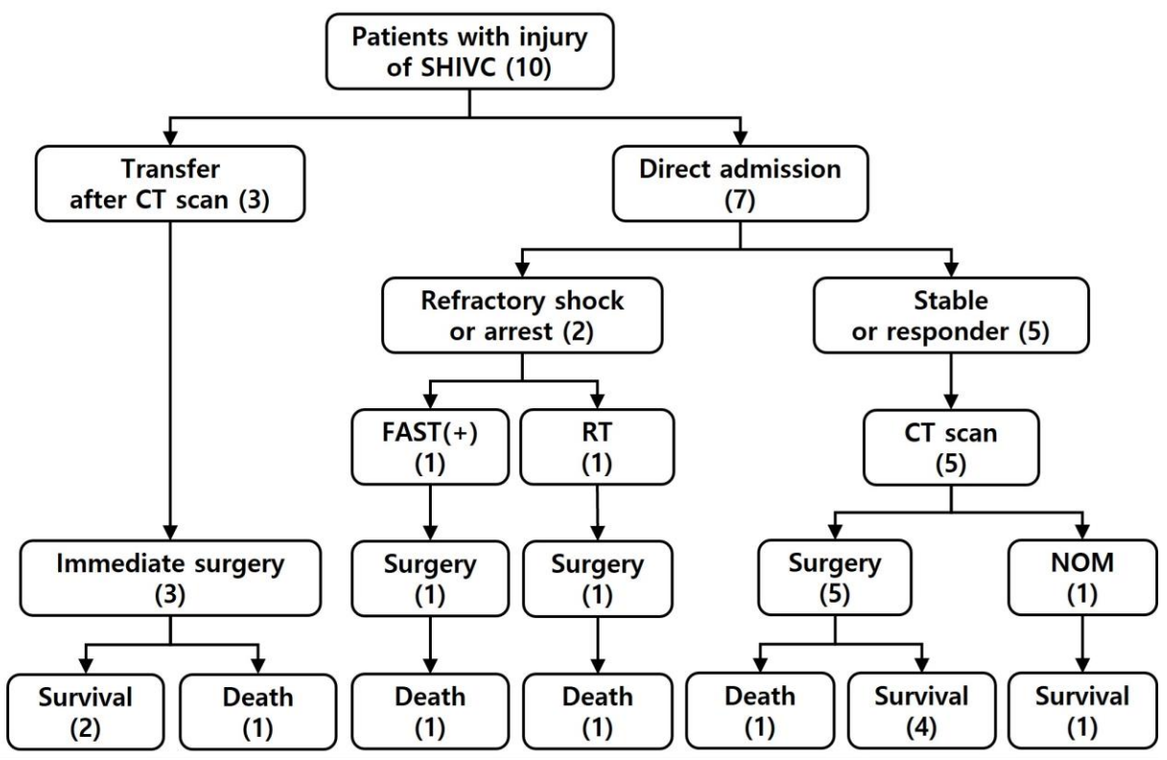
Introduction Inferior vena cava (IVC) injury is an injury with a high fatality rate, and among them, suprahepatic inferior vena cava (SHIVC) has a very high fatality rate. SHIVC injury is a very challenging injury that requires a multidisciplinary approach, including simultaneous surgery of the chest and abdomen and massive blood transfusion. Therefore, a strategy is needed to secure sufficient venous return to the heart during surgery and simultaneously treat commonly associated heart and liver damage. Treatment methods such as cardiopulmonary bypass (CPB), extracorporeal membrane oxygenation (ECMO), and atriocaval shunt are reported. The purpose of this study is to analyze the clinical characteristics and treatment process of SHIVC injuries treated at our institution, review previous studies, and utilize them in future treatment.

Methods We gathered patients with radiologically or surgically confirmed traumatic IVC injuries from the trauma data base of a single trauma center in Korea between January 2014 and July 2023. IVC level were determined by reviewing operation records, surgical images, and radiologic images.

Table 1. Baseline demographics

	Survival (n=6)	Death (n=4)	Total (n=10)	P
Age (year)	44±16	52±20	47±17	0.54
Sex (M/F)	4/2	4/0	8/2	0.63
Admission (Direct/Transfer)	4/2	3/1	7/3	1.00
ISS	34±12	57±21	43±19	0.06
Time to ED (min)	40 [35-77]	64 [40-148]	42 [36-85]	0.35
On admission variables				
Systolic blood pressure (mmHg)*	115±34	70±12	97±35	0.04*
< 90 mmHg*	1 (17%)	4 (100%)	5 (50%)	0.05*
Pulse rate (/min)	100±18	92±19	97±18	0.55
Glasgow coma scale*	9±5	3±0	7±5	0.02*
Laboratory				
Lactate (mmol)	6.7±5.0	14.2±7.2	9.7±6.8	0.08
Base excess (mmol)*	-7.8±7.1	-20.1±5.8	-12.7±9.0	0.02*
INR	1.2±0.2	3.1±2.6	1.7±1.3	0.49
First 24h transfusion (unit)				
pRBC	14±10	10±1	13±8	0.39
FFP	15±12	10±3	13±10	0.31
Platelet*	8±6	0±0	4±6	0.03*
Surgery information (n=9)				
Time to surgery (min)*	220±49	38±18	140±103	<0.01*
Surgery time (min)*	155 [80-195]	56 [45-59]	75 [58-155]	0.02*
EBS for surgery (mL)	4040±2027	4200±2072	4111±1916	0.91

Fig 2. Hospital course



Result During the 10-year study period, there were 10 blunt SHIVC injuries (age 47±17 years; 40% mortality; injury severity score 43±19). 50% of patients had systolic blood pressure SBP <90 mmHg at the time of admission and Glasgow coma scale (GCS) was 7±5. The SBP (70±12 vs 115±34, p=0.05), GCS (3±0 vs 9±5, p=0.02), base excess (-20.1±5.8 vs -7.8±7.1) of non-survival patients (n=4) was statistically significantly lower than that of surviving patients (n=6). Surgical treatment was performed on 9 patients and non-surgical treatment was performed on 1 patient. The most common associate injury was the right atrium (70%), followed by liver injury (n=5, 50%) and diaphragm injury (n=3, 30%). Two patients who underwent intraoperative cardiopulmonary bypass (CPB) survived, and two patients who underwent extracorporeal membrane oxygenation (ECMO) died. Non-survival patients took less time to the operating room (38±18 vs 220±49, p<0.01) and surgery time (56 [45-59] vs 155 [80-195], p=0.02). However, there was no difference in intraoperative blood loss (4200±2072 vs 4040±2027 ml).

Conclusions SHIVC injuries, which have many associate injuries, require a multidisciplinary treatment approach. With recent developments in trauma treatment, trauma resuscitation, and diagnostic techniques, the survival rate of SHIVC injury is improving, and surgical treatment of SHIVC using CPB is an effective method

Table 2. Case information

No	Age	Sex	MOI	ISS	CT	SBP (mmHg)	GCS	BE (mmol)	INR	op time (min)	EBL (ml)	Methods for IVC injury	Major combine injuries	Main Procedures for combine injury	24h pRBC	LOS	Survival
1	29	F	MVA	36	O	92	4	-3.5	1.63	195	6000	primary repair	Diaphragm, Liver	Diaphragm repair, Liver suture, Segmentectomy of liver, Perihepatic packing, Balloon angioplasty	19	44	O
2	32	M	MVA	25	O	75	3	-19.0	1.06	440	1000	patch repair, CPB	RA, Tricuspid valve	RA repair, Tricuspid valvuloplasty & chorda repair, IVC filter insertion	7	46	O
3	51	F	MVA	41	O	130	13	-13.6	0.99	155	5000	primary repair, CPB	RA, Diaphragm, Liver	RA repair, Diaphragm repair, Liver suture, Perihepatic packing	24	26	O
4	30	M	MCA	17	O	158	14	-0.1	1.27	-	-	NOM	Liver, Kidney	Angioembolization	0	12	O
5	60	M	Fall	50	O	144	9	-6.3	1.32	80	3000	primary repair	RA, Aorta, Diaphragm, mesentery, SAH	RA repair, Mesentery suture, TEVAR	25	37	O
6	64	M	MVA	38	O	90	12	-4.0	1.12	75	5200	primary repair	RA, femur fractures	RA repair, ORIF	11	43	O
7	48	M	MVA	75	O	79	3	-26.1	panic	35	4000	primary repair	Liver	Liver suture, Perihepatic packing	12	1	X
8	58	M	MVA	42	O	72	3	-18.6	panic	55	3800	primary repair, ECMO	RA, LA, Liver	RA repair, Liver suture, Perihepatic packing	10	1	X
9	75	M	MVA	75		76	3	-12.8	1.29	60	7000	primary repair, ECMO	RA	RA repair	10	1	X
10	26	M	Fall	35		52	3	-23.0	4.93	58	2000	primary repair	RA, Extensive lung laceration	RA repair, Lung repair Resuscitative thoracotomy and trans-aortic clamp	10	1	X